National Institute of Environmental Health Sciences

A population health model for integrated assessment models

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Year: 2008
Journal: Climatic Change. 88 (1): 35-57

Abstract:

In this paper we present the initial results from a project to develop a population health model so we can extend the scenarios included in the IPCC's Special Report on Emission Scenarios to include population health status. Our initial hypothesis was that some climatic variable, particularly temperature, would have a significant impact on health outcomes. After experiments - using the Global Burden of Disease (GBD) data on Years of Life Lost (YLL) and Years Lived with disability (YLD) both by WHO region and by five degree latitude band as outcome variables - failed, we settled on life expectancy (LE) as the best measure of health status. We discovered that there is a solid relationship between LE and the GBD data from our first experiments, allowing us to extend the results from the LE model. The LE model used cross section data on LE for 91 countries and included temperature, per capita income, access to clean water and sanitation, literacy, simple medical attention, nutrition, per capita medical expenditure, electricity use per capita, and automobiles per capita as independent variables. While all were individually associated with LE, our model of choice included literacy, access to clean water and sanitation, simple medical attention, an indictor variable for Sub-Saharan Africa and purchasing-power parity per capita income. Note that neither temperature nor calories enter into this model. The fit between life expectancy, as predicted by this model, and actual life expectancy was quite good (R(2)Euro Surveillance (Bulletin Europeen Sur Les Maladies Transmissibles; European Communicable Disease Bulletin)0.90), except for Rwanda, Uganda, and Madagascar; these countries accounted for one half of the unexplained variation in the model. The LE model was then used to develop trajectories of life expectancy in India for the four IPCC SRES storylines, where values for the independent variables were extrapolated based on the story line content. YLL and YLD estimates were created using the current cross relationship of these outcomes to LE. Given the lack of a general role for climate in our LE model, future work is planned to explore how to add detailed climate related impacts, to explore alternative nutritional variables, as well as extend the data set to allow a cross-section time-series approach.

Source: http://dx.doi.org/10.1007/s10584-007-9286-8

Resource Description

Climate Scenario :

specification of climate scenario (set of assumptions about future states related to climate)

Special Report on Emissions Scenarios (SRES)

Exposure :

weather or climate related pathway by which climate change affects health

Food/Water Security, Temperature, Unspecified Exposure

Geographic Feature: ☑

resource focuses on specific type of geography

None or Unspecified

Geographic Location: ☑

resource focuses on specific location

Non-United States

Non-United States: Africa, Asia

Asian Region/Country: India

Health Impact: ☑

specification of health effect or disease related to climate change exposure

Morbidity/Mortality

Mitigation/Adaptation: ☑

mitigation or adaptation strategy is a focus of resource

Adaptation

Model/Methodology: ☑

type of model used or methodology development is a focus of resource

Outcome Change Prediction

Population of Concern: A focus of content

Population of Concern: ☑

populations at particular risk or vulnerability to climate change impacts

Low Socioeconomic Status

Resource Type: ☑

format or standard characteristic of resource

Research Article

Timescale: ☑

time period studied

Time Scale Unspecified

Vulnerability/Impact Assessment: ☑

resource focus on process of identifying, quantifying, and prioritizing vulnerabilities in a system

A focus of content